DOCUMENT RESUME

ED 479 457 IR 022 134

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TITLE	Aligning Theory and Web-Based Instructional Design Practice with Design Patterns.
PUB DATE	2002-10-00
NOTE	8p.; In: E-Learn 2002 World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education. Proceedings (7th, Montreal, Quebec, Canada, October 15-19, 2002); see IR 022 093.
AVAILABLE FROM	Association for the Advancement of Computing in Education (AACE), P.O. Box 3728, Norfolk, VA 23514. Tel: 757-623-7588; e-mail: info@aace.org; Web site: http://www.aace.org/DL/.
PUB TYPE	Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS
DESCRIPTORS	*Computer Assisted Instruction; Course Content; Design Preferences; Designers; *Distance Education; *Instructional Design; Instructional Development; *Instructional Materials; Internet; World Wide Web
IDENTIFIERS	*Instructional Theory

ABSTRACT

Designing instructionally sound Web courses is a difficult task for instructors who lack experience in interaction and Web-based instructional design. Learning theories and instructional strategies can provide course designers with principles and design guidelines associated with effective instruction that can be utilized in the design of Web-based instruction (WBI). However, it can be difficult, especially for novice course designers, to operationalize these theories and apply them to the design and development of specific Web courses. Effective design methods for WBI that focus on student learning are needed. Design patterns have emerged as a means to capture design knowledge and present design solutions to designers. Design patterns can be used to effectively support novice designers of Web-based courses. This paper discusses how design patterns that capture pedagogical principles and good design strategies can be used to support educators in designing instructionally sound Web-based courses. A design framework for WBI is presented and the resulting pattern language is introduced. (Contains 28 references.) (Author)

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Aligning Theory and Web-based Instructional Design Practice with Design Patterns

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Abstract: Designing instructionally sound web courses is a difficult task for instructors who lack experience in interaction and web-based instructional design. Learning theories and instructional strategies can provide course designers with principles and design guidelines associated with effective instruction that can be utilized in the design of web-based instruction (WBI). However, it can be difficult, especially for novice course designers, to operationalize these theories and apply them to the design and development of specific web courses. Effective design methods for WBI that focus on student learning are needed. Design patterns have emerged as a means to capture design knowledge and present design solutions to designers. We believe design patterns can be used to effectively support novice designers of web-based courses. This paper discusses how design patterns that capture pedagogical principles and good design strategies can be used to support educators in designing instructionally sound web-based courses. A design framework for WBI is presented and the resulting pattern language is introduced.

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Introduction

The World Wide Web (WWW) has become one of the fastest-growing mediums for the delivery of distance education. With entire degree programs now being offered online, instructors from a variety of academic areas are developing instructional materials for distance learning programs. Many of these instructors are novice web designers and have received no training in interaction and web-based instructional design (Braxton, 2001; Tennyson 1995). The need for design support is a major issue in the design of web-based instruction (WBI) as the poor design of courses is one of the key problems with learning from the Web (Bork & Britton, 1998; Kessler, 1999). Hirumi (2002) found that novice course designers find it difficult to incorporate the types of meaningful interactions needed in distance learning courses. As a result, courses are often developed by posting large text documents to the Internet, which may present students with a lot of information, but are not effective for student learning (Kessler, 1999). Furthermore, widely used web course management systems like WebCT and Blackboard are indeed just that, course management systems. They provide little support, if any, for effective design of web-based instruction.

The instructional design of course materials directly affects learning effectiveness (Clark 1994; Jonassen, 1988). This is especially true for web-based instruction due to the mere nature of the Internet and the type of interaction it provides. Practices that a good and experienced teacher might automatically encourage in the traditional classroom setting have to be purposefully designed for and supported via the proper design of the web-based course. Discussions in small groups or recognizing the fact that some students are confused by way of their facial expressions are features that are not automatically or trivially supported by a website. To promote effective instruction, web-based courses must be designed with a focus on the opportunities and capabilities afforded by the Web in relation to instructional design and learning theories (Khan 1997, Hannum 1998). However, the theories are abundant and end-users have difficulties in their application to online course materials.

Support for novice course designers through design methods grounded in sound instructional and educational theory are needed. We propose that using design patterns as a mechanism for capturing pedagogical strategies and good design practices can assist educators in designing instructionally effective web courses. Whereas theories can be abstract and difficult to apply, patterns are more procedural and present design knowledge in a way that can be adapted and re-used. Design patterns have traditionally been used to provide design support to novice designers in the fields of architecture (Alexander 1977, 1979) and software

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engineering (Gamma, 1995), and are now being explored within the human-computer interaction (HCI) community (Borchers, 2001; Tidwell 1999).

This paper presents our approach for providing design support to novice course designers using design patterns. We begin with an overview of design patterns and examine their use for WBI. We then discuss how research from learning and instructional theory can be used to provide an appropriate design framework that supports the development of design patterns. Finally, we describe our efforts towards the development of a pattern language for web-based instruction and present an example pattern from the language.

Design Patterns

A design pattern can be defined as an approach for capturing and presenting design knowledge to solve problems. They act as a design aid to dissimilate expert knowledge to novice designers. Design patterns usually exist within a language with other patterns addressing design problems in that same domain. Although the format can differ, patterns usually contain many sections:

1. The **Pattern Name** identifies the pattern and provides a way to communicate about the pattern.
2. The **Problem** describes when to apply the pattern explaining both the problem the pattern is trying to solve and the context surrounding it.
3. The **Solution** describes the elements that make up the design explaining to the user how to solve the problem.
4. The **Forces** describe the results and trade-offs of applying the solution.

Other elements that are often included in a pattern include an *example* of the solution, a list of *related patterns*, and a *rational* section explaining how or why the solution solves the problem. The information contained in a pattern is not new or invented. This information comes from looking at examples of successful design solutions or at expert design knowledge and experience. Patterns provide a way to represent this knowledge in a form that supports inexperienced designers. Although patterns are of great benefit for novices, they are still very useful to experts as patterns can be used to communicate interesting design ideas to other experts.

Patterns were first used in the field of architecture (Alexander 1977, 1979) to support the design of modern architectural structures. This work resulted in a pattern language consisting of 253 design patterns that present solutions to problems encountered in architectural design. The patterns range in scale from patterns for the distribution of towns and neighborhoods to houses and rooms. An example is the *Bus Stop* pattern, which addresses problems concerning the design of a bus stop. The *context* is any town who public transportation is based on buses, and some of the *forces* are that bus stops need to be easy to recognize and people waiting there should feel safe. The *solution* suggests to the designer to build bus stops so that they work together with other activities in the area such as a newsstand or coffee shop. An illustration of the solution is also provided for the designer. The goal of this work was to support both architects and the general public in designing quality towns, neighborhoods, and homes.

Building upon this work, design patterns have been used within software engineering to document design experience for less experienced software developers in the areas of object-oriented technology (Gamma et al., 1995). These patterns have also been used as an educational tool to teach computer science curriculum and to document successes in teaching object-oriented technology to undergraduate students (Gelfand, 1998; PPP 2000).

Design pattern usage is a relatively new idea in the field of HCI to support the design of user interfaces and usable systems (Borchers, 2001; Tidwell 1999). Traditionally, design guidelines have been used to capture design knowledge to support designers within this domain. However, guidelines have come under scrutiny on their ability to actually solve design problems. Mahemoff (1998) contends that guidelines are not very useful in solving specific design problems because they are too abstract to apply to specific design projects. Others point out that with guidelines, it is difficult to see the actual problem addressed by the guideline, whereas a pattern makes both the problem and the context explicit (van Welie, 2000). In addition to solving problems, pattern languages are also useful for helping a designer to find problems within his design by helping to raise the designer's awareness of potential problems. This can be a powerful design and training aid for a novice designer.

Design Patterns for Web-based Instruction

Sound pedagogical practices are not often integrated into the web-course design and authoring process (Hannafin, 1997; Janicki 2001). The difficulty lies in operationalizing the guidelines and principles from the various theories into the design and development of instruction. Principles such as "design courses that are motivating" or use "exploratory-based instructional strategies" are quite abstract and difficult to apply to the design of specific courses. Trying to use and apply principles such as these suffers from of the same type of problems as guideline usage within HCI design. Design patterns can provide a mechanism for capturing pedagogical strategies and good design practices in a way that supports novice course designers in designing instructionally sound web-based courses. A pattern-based design approach to WBI can support the alignment of educational theory with actual design practices. With design patterns, we can utilize a theory-supported, but problem-solving approach to the design of web-based courses.

Towards a WBI Pattern Language

We have been working towards the development of a pattern language for web-based instruction. Our goal is that this pattern language will support novice web instructors in the design of quality distance learning materials for students. As a foundation for the language, we use learning and instructional theories to develop an appropriate design framework for WBI. Research from this body of literature identifies a number of principles associated with effective instruction that can be utilized in the development of design patterns that solve web-course design problems. The resulting design framework shown in Table 1 merges key design concepts from both behavioral and cognitive theories on learning (see Kearsley, 2001 & Mergel, 1995) with research from web-based instructional design models (Duchastel, 1997; Kearsley, 1999). As advocated by Morrison (2001), we adopt a view that it is good to incorporate both behavioral and cognitive approaches to learning in the design of web-based instruction in order to reap the benefits of each to address diverse student populations.

• Provide Structure to the learning process	• Encourage student Expression and Reflection
• Provide a Foundation for learning	• Design for Interactivity
• Specify Learning Objectives	• Build Learning Communities
• Encourage Student Participation	• Include Authentic Content and Activities
• Give Feedback and Guidance	• Provide Problem Solving Activities
• Provide Support Aids	• Provide Multiple Perspectives and Representations

Table 1: WBI Design Framework

We have an initial language of about twenty design patterns that embody the design philosophy represented by the framework described above, but from a problem-solving perspective. The language addresses design problems from overall course presentation to specific student learning activities As shown in Figure 1, we have chosen a categorization for the design problems in WBI based on three elements: *content, learning activity,* and *learning support.* This model or categorization for design problems in web-based instruction builds upon the model presented by Oliver (2000) for the design of WBI based on principles from situated learning theories. Patterns in the content category help with the presentation and structure of the learning process. Learning Activity Patterns provide solutions to problems concerning activating and enhancing student learning. Learning Support Patterns address problems with proving support to web students.

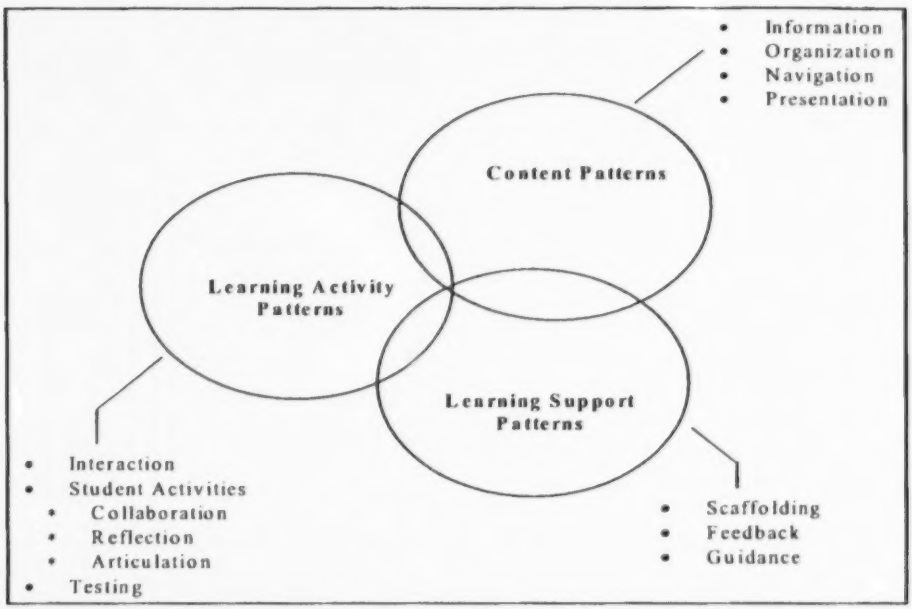

Figure 1: WBI Problem Space

The format used for writing the patterns contains the standard pattern elements such as *problem*, *context*, *solution*, and *forces*, in addition to a *rational*, *related patterns*, and *reference* section. The reference section is used to validate the information contained in the pattern and to give the designer additional resources. An abbreviated pattern from the language is provided in Figure 2. This pattern named "*FAQ*" addresses how to handle students' problems or questions. The solution given by the pattern is a strategy for providing immediate feedback for student inquiries. Although not shown here, patterns also contain an example of the solution given by the pattern. Space does not permit us to present each pattern in detail. However, the following few pattern names and descriptions are provided to give an idea of the range of problems addressed in the language.

Learning Community: Addresses the isolation problem experienced by some web-based students. The problem is how to facilitate a sense of community for online students. The pattern's solution supports the creation of collaborative learning communities.

Discovery Orientation: Addresses the disorientation that can be experienced by students in courses that provide little organization and link to many additional web sites. The problem is how to help students orient themselves within the learning space.

Teamwork: Addresses the problem of coordinating teamwork over the web for group projects and assignments. The pattern solution's encourages the instructor to take the role as facilitator to assist students.

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Pattern Name: FAQ

Problem: Students have problems and questions that necessitate quick responses.

Context: Any web-based course consisting of students whose location may be different from that of the instructor's location or who are novice web students.

Forces:
- Emails from students can quickly fill up an instructor's email account.
- Multiple students may have the same question.
- The time involved in answering questions can be substantial.
- Student's work hours may be different from instructor's hours.
- Students want quick responses.

Solution: Create a document in the course that contains a list of questions along with the answers. Include questions that have been already asked by students and if you have taught the course before, you can include common questions from previous students. It would also be beneficial to include any questions that you anticipate students may have. To insure that students utilize this document, encourage them to refer to it as a resource tool for them to address many of their concerns.

Example: *(Omitted)*

Rationale: It is frustrating for students to have questions and not be able to get immediate answers to them. FAQ provides a mechanism for handling student questions that gives them immediate feedback.

Related Patterns: *Feedback-Loop*

References:
Dick, W. & Reiser, R. (1989). *Planning Effective Instruction*
Gagne, R. (1985). *The Conditions of Learning and Theory of Instruction*
Khan, B. (Ed). (1997). *Web-Based Instruction*
Shaw, R. (1996). *The FAQ Manual of Style.*

Figure 2: WBI Design Pattern

A pattern language for WBI stills allows for some creativity in the design of instruction, as they do not remove the role of the instructor from the instructional design process. As Vlissides (1998) points out, design patterns do nothing to remove the human from the creative process of design. Design patterns serve to support a possibly inexperienced, but otherwise capable person. Our goal is that novice web-course designers will become better course designers by using the pattern language.

Conclusion

Design patterns have emerged as a way to capture knowledge to present design solutions to novice designers. We have presented our efforts towards the development of design patterns and a resulting pattern language for web-based instruction to support novice web-course designers. We believe a pattern language for WBI based on principles from instructional design and learning theories can support the design of instructionally effective web-based courses. We have coupled this pattern language within a design environment for web-based instruction that scaffolds the process of finding, selecting, and applying patterns to course design problems (Frizell & Hübscher, 2002).

References

Alexander, C. (1979). *The Timeless Way of Building.* Oxford University Press, New York.

Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I. and Angel, S. (1977). *A Pattern Language*. Oxford University Press, New York.

Borchers, J. (2001). *A Pattern Approach to Interaction Design*. John Wiley & Sons.

Bork, A. and Britton, D.R. (1998). The Web is Not Yet Suitable for Learning. *Computer*, 31(6), 115-116.

Braxton, S. (2000). Empirical Comparison of Technical and Non-Technical Distance Education Courses to Derive a Refined Transactional Distance Theory as the Framework for a Utilization-Focused Evaluation Tool. Dissertation, Graduate School of Engineering and Applied Science, The George Washington University.

Clark, R.E. (1994). Media will never influence learning. *Educational Technology Research and Development*, 42, 21-30.

Duchastel, P. (1997). A Web-based Model for University Instruction. *Journal of Educational Technology Systems*, 25(3), 221-228.

Frizell, S. and Hübscher, R. (2002). Supporting the Application of Design Patterns in Web-Course Design. *Proceedings of the World Conference on Educational Multimedia, Hypermedia, and Telecommunications*. Denver, CO.

Gamma, E., Helm, R., Johnson, R. and Vlissides, J. (1995). *Design Patterns: Elements of Reusable Object-Oriented Software*. Addison-Wesley.

Gelfand, N., Goodrich, M., and Tamassia, R. (1998). Teaching Data Structure Design Patterns. *SIGCSE*, ACM Press.

Hannafin, M., Hannafin, K., Land, S. and Oliver, K. (1997). Grounded Practice and the Design of Learning Systems. *Educational Technology Research and Development*, 45(3), 101-117.

Hannum, W.H., Web Based Instruction Lessons: The Uses of Web-based Instruction http://www.soe.unc.edu/edci111/8-98/index_wbi2.htm

Hirumi, A. (2002). The Design and Sequencing of e-Learning Interactions: A Grounded Approach. *International Journal on E-Learning*, 1(1), 19-27.

Janicki, T. and Liegle, J. (2001). Development and Evaluation of a Framework for Creating Web-based Learning Modules: A Pedagogical and Systems Perspective. *Journal of Asynchronous Learning Networks*, 5(1).

Jonassen, D.H. (1998). *Instructional Designs for Microcomputer Courseware*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Kearsley, G. (2001). Explorations in Learning & Instruction: The Theory Into Practice Database. Available at: http://tip.psychology.org/

Kearsley, G. and Shneiderman, B. (1999). Engagement Theory: A framework for technology-based teaching and learning. Available at: http://home.sprynet.com/~gkearsley/engage.htm

Kessler, G., Rosenblad, K., and Shepard S. (1999). The Web Can Be Suitable for Learning. *Computer*, 32(2), (pp. 114-115).

Khan, B.H. (1997). Web-Based Instruction (WBI): What Is It and Why Is It? In B.H. Khan (Ed.), *Web-Based Instruction*. Englewood Cliffs, NJ: Educational Technology Publications.

Mahemoff, M. and Johnston, L. (1998). Principles for a Usability-Oriented Pattern Language. In Calder, P. and Thomas, B. (Eds.), *OZCHI'98 Proceedings*, pp. 132-139. Los Alamitos, CA.

Mergel, B. (1995). Instructional Design and Learning Theory. Available at: http://www.usask.ca/education/coursework/802papers/mergel/brenda.htm

Morrison, G., Ross, S., and Kemp, J. (2001). *Designing Effective Instruction.* John Wiley & Sons.

Oliver, R. and Herrington, J (2000). Using situated Learning as a Design Strategy for Web-based Learning. In B. Abbey (Ed.), *Instructional and Cognitive Impacts of Web-Based Education.* Idea Group Publishing.

PPP. (2000). The Pedagogical Patterns Project, Successes in Teaching Object Technology. Available at http://www-lifia.info.unlp.edu.ar/ppp/

Tennyson, R. & Elmore, R. (1995). Integrated Courseware Engineering System (ICES), In R. Tennyson & A. Barron (Eds.), *Automating Instructional Design: Computer-Based Development and Delivery Tools.* Springer-Verlag Berlin Heidelberg.

Tidwell, J. (1999). Common Ground: A Pattern Language for Human-Computer Interface Design. Available at: http://www.mit.edu/~jtidwell/interaction_patterns.html

van Welie, M., van der Veer, G., and Eliens, A. (2000). Patterns as Tools for User Interface Design. *International Workshop on Tools for Working with Guidelines.* Biarrite, France.

Vlissides, J. (1998). Pattern Hatching: Design Patterns Applied. Addison-Wesley Longman, Inc.

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